GOVERNMENT USE ONLY

GUO: 2368

14 April 1967

TRANSLATIONS ON FRENCH NUCLEAR, MISSILE, SPACE, AND RELATED MILITARY DEVELOPMENTS

No. 91

DTIC QUALITY INSPECTED 3

DISTRIBUTION STATEMENT A
Approved for public release;
Distribution Unlimited

U. S. DEPARTMENT OF COMMERCE

CLEARINGHOUSE FOR FEDERAL SCIENTIFIC AND TECHNICAL INFORMATION

JOINT PUBLICATIONS RESEARCH SERVICE
Building Tempo E
Adams Drive, 4th and 6th Streets, S.W.
Washington, D.C. 20443

19980109 166

GOVERNMENT USE ONLY

GUO: 2368

TRANSLATIONS ON FRENCH NUCLEAR, MISSILE, SPACE, AND RELATED MILITARY DEVELOPMENTS

No. 91

This serial publication contains translations of selected articles, mostly from French-language sources, on nuclear, missile, space, and related military developments in France. Complete bibliographic information accompanies each article.

CONTENTS

LAUNCHING ANNOUNCED OF *REDOUTABLE*, FIRST FRENCH NUCLEAR SUBMARINE

[Following is a translation of an article by Jean Le Lorrain, in the French-language daily newspaper, *La Nation* (The Nation), Paris, 21 March 1967, page 2.]

To be launched next 29 March at Cherbourg in the presence of General De Gaulle, this floating fortress, unique in Europe, initiates the second step in the deterrent force

On 29 March, at Cherbourg, General De Gaulle is going to give the send-off to the French atomic fleet by presiding over the launching of our first nuclear-propelled submarine, the *Redoutable*. The *Redoutable*, which is 128.7 meters long with a 10.6-meter beam, displacing 8,000 tons on the surface with a 10-meter draft, will be able to make an average speed of 20 knots on the surface. A real underwater plant, it is the first of a series of three ships (the second is already under construction) provided for by the 1965-1967 Program-Law, approved by Parliament. It also is the second step in the deterrent force.

With a double crew of 135 men each who will take turns in making submarine patrols of about 60 days, the *Redoutable* will be operational in 1969; that is to say that two years from now it will be able to fulfil every mission that it might be assigned in case of necessity. It is the largest submarine ever built in Europe. A letter and three figures -- Q-252 --define it better in the eyes of the military experts than its romantic patronymic. The *Redoutable*, alias Q-252, is actually the synthesis of a series of studies conducted by means of the various prototypes and experimental productions developed in the Cherbourg Naval Shipyard since the *Gymnote*, designated as Q-251, which was built on the infrastructure of the old Q-244, a traditional-type submarine that has become the experimental platform for the missiles that will equip our atomic fleet. The other pole of these experiments was the land-based prototype of the nuclear reactor developed by the engineers of the Atomic Testing Center (*Centre d'Essais Atomiques*) in the Cadarache plant.

Like the *Gymnote*, which must not be confused with its 1888 ancestor, the first French submarine of the same name, created by Engineer Gustave Zede, the *Redoutable* has been designed by Engineer Gempp, Chief Engineer of the Naval Construction Corps. But the difference between this real floating fortress and the traditional submarines is enormous.

An Atomic Steamship

In the first place -- and it is rather amusing to observe --, there is a return, with this type of propulsion, to steam navigation, since the engine of our first atomic ship is nothing other than a nuclear "boiler", and this explains the cigar-shape chosen for this submarine. A cigar that contains, it is true, sixteen tubes for launching ballistic missiles with a nuclear warhead -- a real steel "Sherwood Forest" -- which appear in the form of a two-stage rocket, ten meters high, weighing more than fifteen tons and that can be projected outside the ship while it is proceeding slowly, by means of a compressed-air device. These MSBS (*Mer-Sol-Balistique-Strategique* = Sea-to-Land-Strategic-Ballistic) missiles have been tested particularly at the Landes firing center. They have a range of several thousand kilometers. They could even be launched when the ship is submerged. They are then propelled into the atmosphere by a powder charge, like the rockets that carry our satellites. All these devices are of entirely French production.

Amazing Radius of Action

Another characteristic that differentiates between an atomic submarine and an ordinary submarine is, obviously, its amazing radius of action, which results from the utilization of a practically inexhaustible nuclear engine, thanks to which the *Redoutable* will be able to sail for three years at a stretch, without the need for recharging the reactor's atomic core. It will develop a power of at least 20,000 hp. Its production stems from the prototype undertaken at Cadarache as early as 1960 and put in operation by first going critical on 14 August 1964. In the weeks that followed, that is to say after the commencement of atomic fission which produces power, they proceeded to bring it up to maximum power for a fictitious cruise that ran off without difficulty. In January of this year, this prototype that has been remarkably successful already had accumulated the equivalent of 460,000 kilometers of ocean sailing -- eleven times around the world!

For the 1969 "Rendezvous"

Like the Cadarache prototype, the actual nuclear engine of the *Redoutable* will be supplied with enriched uranium provided by the Pierrelatte isotope separation plant. It is one of the components of the French 1969 "atomic rendezvous", when the various force systems will be integrated to set up a powerful defense and deterrent force, ranging from traditional frigates equipped with long-range missiles to naval

aviation and including other ultra-modern means, like missiles.

The nuclear submarines form the second generation of the strategic nuclear force that will make France the third power in the world, if not in the immediate future the equal of the other great nuclear powers, and it will provide France with every guarantee of independence and security by means of the capability of an immediate reply in case of attack.

Third World Power

Let us recall that when Mr. Pierre Mendes-France was Prime Minister, in 1954, he was the one who had the production of the French atom bomb placed under study and that Mr. Guy Mollet's government, in which Mr. Mitterrand was Minister of Justice, was the one that announced to the country, in 1956, that France had just become committed to the course of the military atom. The difference is that today France is producing its own uranium and is no longer obliged to ask Washington for some, or to depend on decisions by the Pentagon to assume its defense and diplomacy. The difference also is that France has been at peace since the beginning of the last Legislature, for the first time in a quarter of a century.

The *Redoutable* will provide France with the means for preserving this peace, while awaiting an eventual true world-wide disarmament, that is to say, general and supervised disarmament.

Ile Longue: Future SSBN Base

The future base for the French nuclear submarines will be Ile Longue which is close to the Crozon Peninsula opposite the Port of Brest. Construction work will be undertaken in two main sections. The first one aims at improving the port facilities of the site; the second will provide it with its complete capability; that is to say that it will make it possible to stock and maintain the equipment for the SNLE (*sousmarins nucleaires lance-engins* = missile-launching nuclear submarines [SSBN]).

The *Terrible*

At present, several hundred workers are working on the *Redoutable* on the ways at Cherbourg. A second ship, which will probably be named *Le Terrible*, is under construction on neighboring ways. The third one in the series will probably be launched in Brest.

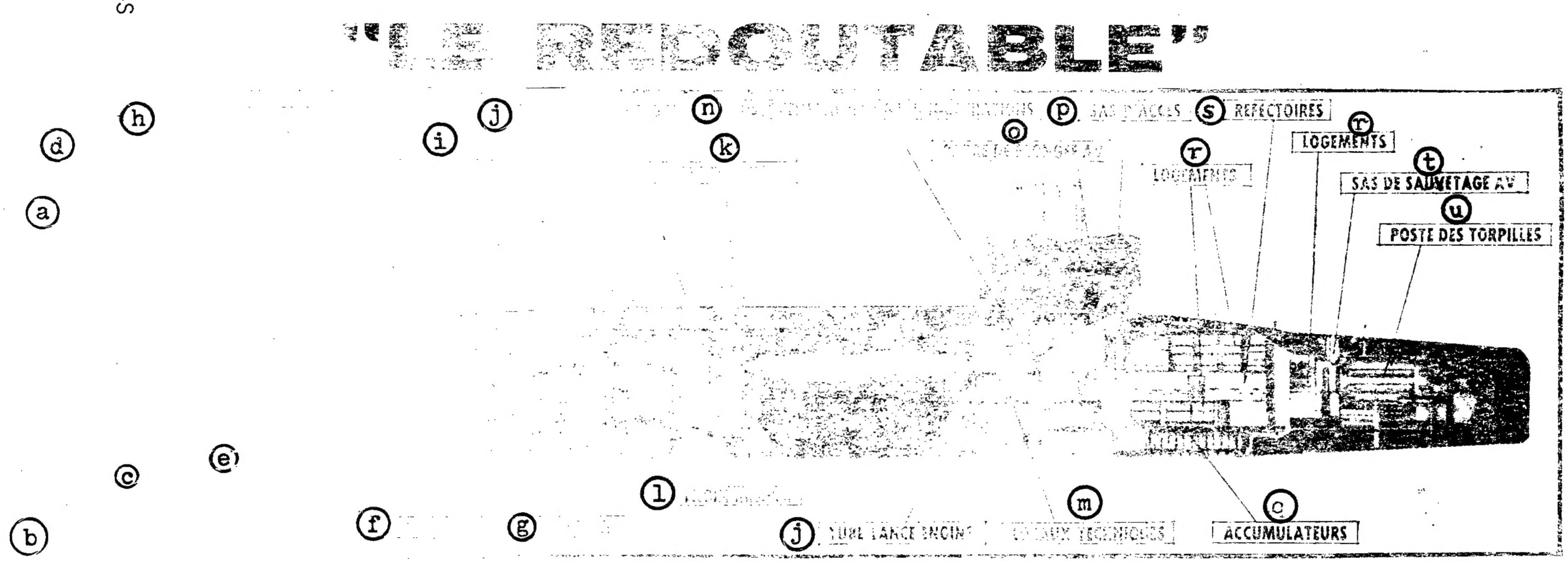
Credits Will Be on the Decrease

After a very definite rise, the curve of French atomic credits has recently flattened out. It is now going to head downwards. In 1966, in the military budget, transfers to the Atomic Energy Commission

represented 2,725,000,000 francs. In 1967, they go up to 2,810,000,000 francs, which represents a decrease in the relative amount of military credits. On the other hand, in 1967, for those 2,810,000,000 francs of payment credits, only 2,461,000,000 for program authorizations have been transferred, which means that for 1968 and 1969 -- taking into account the shift in weight -- the payment credits transferred to the Atomic Energy Commission will also decrease.

Why Now?

The Government decided to have the atomic submarine launched in the month of March, not "in the crush of the elections", but merely because it is necessary to launch it and because this operation can be performed only during one of the two large tides of the year -- one of the equinoctial tides -- around 20 March and 20 September. The military experts want therefore to avoid a six-month delay in the scheduled planning for the development of the deterrent force. With regard to fuel supply, let us point out that Pierrelatte will be entirely operational during this very year, two or three months ahead of the scheduled date.



LEGEND: a = stern diving plane; b = vertical rudder; c = vertical stabilizer; d = auxiliary electric motor; e = lube oil storage tanks; f = ballast tanks; g = reactor; h = after escape lock; i = after access trunk; j = missile launching tube; k = upper [missile] hatch; l = strategic ballistic sea-to-land missile; m = technical equipment compartments; n = navigation-operations control center; o = forward diving plane; p = [forward] access trunk; q = batteries; r = living compartments; s = mess-halls; t = forward escape lock; u = torpedo room

10,042
CSO: 4600-S

FIRST FRENCH BREEDER REACTOR TO BE BUILT AT MARCOULE

[Following is a translation of an unsigned article in the French language newspaper Combat, Paris, 17 March 1967, page 10.]

The decision has been made: "Phenix" the first French prototype reactor of the breeder reactor type will be built at Marcoule, it was announced by the French AEC [CEA].

Having a power of 250 MWe (250,000 electric kilowatts), or a bit more than the tidal power plant on the Rance estuary, "Phenix" will enter into construction in 1969. It will cost some 500 million francs and is scheduled to begin operation in 1973.

"Phenix" will be one of the future reactors which will create more plutonium than they use up. While in present day nuclear reactors it is possible to extract an amount of energy from a ton of uranium equivalent to that produced by 10,000 to 30,000 tons of coal, in the breeder reactors, which are called "fast-neutron" reactors, the energy will be equivalent to that of 300,000 to 600,000 tons of coal, or 20 to 50 times more.

"Phenix" will for that matter only be an intermediate stage on the path towards the future power generators. It is to be placed between the experimental reactor "Rapsodie" of 20 MW (20,000 thermal kilowatts) power which went critical last 28th of January at Cadarache, and the 1,000 MW (one million electric kilowatts) reactor which will be built after the 1970s and which will be of the fast-neutron type.

The role of "Phenix" will be above all to furnish in its construction and operation the basic technical and economical data which can be applied directly to the design of the future large generators. It will nevertheless furnish large quantities of electric current, equivalent or even greater than the tidal station on the Rance.

This is incidentally one of the reasons that "Phenix" will be built at Marcoule, rather than at Cadarache. The integration into the power network

is practically complete there and the Rhone river can furnish the large quantities of water needed for cooling the reactor more easily than could the Durance river.

"Phenix" will be the sixth reactor built at the Marcoule site, following the plutonium-producing G1, G2 and G3 reactors and the tritium-producing reactors "Celestin 1" and "Celestin 2" which are presently under construction.

All of the large nuclear powers are planning, or already building, breeder reactors.

The Russians are building a 350 MWe one, BN 350, at the edge of the Caspian Sea. Half of its power, 150,000 kilowatts, will be used for producing electric current and the other half will be used as the heat source in a large water desalinization plant.

The British started construction less than a year ago on a fast-neutron reactor, PFR, of 250,000 kw power at Dounreay.

The United States have several experiments and projects underway and the West Germans are also getting ready to begin work on two of this type of reactor of 250,000 kw power, one cooled by gas and the other by liquid sodium.

The fast reactors will require large quantities of plutonium to get started and for their first years of use. "Phenix" for example will require nearly a ton of plutonium for the first fueling of its core and nearly double that for its first years of operation. Later, however, these reactors will over-produce large quantities of plutonium which can be used in other reactors, in addition to producing electric power.

7104

CSO: 4600-D

MISSILES FIRED FROM THE LANDES TEST CENTER WILL BE TRACKED BY SPECIALLY EQUIPPED AIRCRAFT

[Following is a translation of an article by "N.V." (Nicholas Vichney) in the French-language newspaper Le Monde (The World), Paris, 23 February 1967, page 18.]

The Defense Ministry and the UTA airlines company presented two specially equipped aircraft to the public at Le Bourget airfield on Tuesday. These aircraft will participate in the development shots of the future missiles of the "dissuasion force", which will be test-fired from the Landes center. The two four-motor DC-7 aircraft have received the designation AMOR (aircraft for measurement and observation at recovery).

Along with the station installed on Flores island (Azores archipelago) and the rapid escorter "Guepratte", which will be later joined by the measurement ship "Henri-Poincare", the AMOR will constitute the surveillance and tracking facilities for the ocean part of the test range. Two have been built and the third is being completed.

It is often towards the high seas that missiles are pointed when fired to study their behaviour: propulsion, guidance, command and re-entry into the dense layers of the atmosphere. This method is required in all cases where there is no available range sufficiently large and deserted. Thus most countries launch into the oceans during the development of their medium range missiles--2000 to 3000 km--and this mode of operation is imperative for the development of intercontinental missiles--over 8000 km range.

However, to make a missile fall into the ocean still implies that the impact position can be precisely determined and that data telemetry transmitted from the missile in the last stages of its flight can be recorded. In order to carry out these missions the Firing Range Equipment Service [SECT], the Flight Test Center [CEV] and the Directorate for Research and Test Facilities [DRME] have been collaborating with the UTA company to develop the AMOR, relying thus on a method which has been extensively used by the Americans.

Taking off from the Azores base at Santa Maria, an AMOR--which could be replaced by another craft maintained in an alert status at the same base--would place itself at a spot in the course of the trajectory just as the missile is fired from the Landes center and will proceed toward the impact zone--the recovery area--which is situated some 120 km from the base.

It will receive the telemetry data broadcast by the continuous emitters contained in the head of the missile and then, advised by the Landes center of the theoretical coordinates of the impact point, it will try to spot the missile at sea. Previously it will have proceeded with a medium altitude surveillance of the recovery area to note the presence of any ships.

The carrying out of such a mission has required the installation of much special equipment on board these aircraft. They must obviously have a movable antenna for the reception of telemetric data and a radar to be used for surveillance as well as to locate the spout of water raised by the missile's impact on the ocean.

The aircraft must also have clocks ensuring perfect chronometry of the recordings, and these clocks will have to be synchronized with those in the other stations before the shot. In addition the aircraft must be equipped with an extremely precise navigation system. It may indeed happen that delays in the firing of the missile will force the aircraft to cruise for hours in the recovery area and it must not deviate from the planned position, although no outside assistance can be given to it in order to improve its navigation.

In addition, only a truly precise knowledge of its path will allow it to localize the impact point in a satisfactory manner. Finally, the aircraft must carry recording devices which will allow it to store data transmitted by the missile in real time and also to gather data after the shot from the "Guepratte" and the Flores island station in order to return them to France as quickly as possible.

The AMOR, which naturally have a large flight autonomy--some 25 hours--thus differ from ordinary DC-7Cs in that they have a large radome 3m long and 1.8m wide on their back which shelters the antenna for telemetry reception and another radome underneath which houses the radar antenna. The disposition of the cabin has been completely modified in order to carry all the electronic apparatus necessary for navigation and the recording of data.

The two aircraft now in use have already taken part in the analysis of three real night launches from Hammaguir as well as a simulated operation carried out at the Landes test center. They are thus already considered operational and will be able to participate in the series of shots that the Landes center is to begin in June.

7104

CSO: 4600-D

MONKEY LAUNCHED ON BOARD ROCKET SEEMS TO HAVE STOOD WEIGHTLESSNESS TEST WELL

[Following is a translation of an unsigned article in the French language newspaper Le Monde (The World), Paris, 9 March 1967, page 12.]

The launch on Tuesday of the monkey "Martine" from Hammaguir on board a Vesta rocket was carried out according to plan and the experiment seems to have furnished the expected results on the effects of weightlessness on a living organism.

The capsule in which the monkey was placed reached an altitude--238 km--very close to the planned one; the slowing of the fall of the capsule, first by air-brakes and then by a parachute was carried out correctly and the recovery of the missile and its occupant, 158 km from the launch point, was carried out in a sufficiently short period of time: one hour and fifteen minutes.

The nature of the scientific information provided by the operation is still unknown. It will take a certain amount of time to decipher the signals sent to the ground by telemetry during the flight, especially during the eight and one half minutes of weightlessness.

A first analysis, however, has shown that the monkey seems to have well withstood the lack of gravity to which it was subjected. The animal had been trained to push a button--to be chosen among four others--every time a red light signal was given to it; upon doing this it received a fruit paste as a reward. The question was whether weightlessness would change the effects of this training in one way or another. According to the first results there was no change: having had its food witheld before the flight, the monkey was allowed to feed itself well during its brief journey in space.

Another, completely analogous, experiment is to be carried out in the next few days.

7104

CSO: 4600-D

MONKEYS ON VESTA: EIGHT MINUTES OF WEIGHTLESSNESS

[Following is a translation of an article by P.C. in the French-language periodical Air et Cosmos (Air and Cosmos), Paris, Vol 4, No 190, 11 Mar 67; pp 16-17.]

On 7 Mar, at 1144 hours (French time), the technicians of CIEES (Centre Interarmes d'Essais d'Engins Speciaux; Interbranch Center for Testing Special Rockets) launched, from Hammaguir, the first of two Vesta rockets (the second is to be fired eight days later), each of which carries a small female monkey aboard. The object of these experiments is to obtain data on the behavior of the living organism in the absence of gravity.

The shot carried out on 7 Mar was successful. Vesta attained the expected altitude of 240 km; it carried a 190 kg payload in the nosecone of a Veronique rocket, and it was even ballasted down in such a way as to prevent it from rising too high and from causing the animal to suffer too much in the deceleration phase when returning to the low atmospheric layers. Nine minutes after launching a parachute opened and four minutes later the capsule and its passenger were deposited in the desert 150 km from the launching site. The monkey, named "Martine," was recovered live one hour later, and it seems that she has carried out well the tasks which she was expected to perform during the flight lasting, on the whole, 13 minutes.

The program is directed by CNES (Centre National d'Etudes Spatiales; National Center for Space Research), while CERMA (Centre d'Enseignement et de Recherche de Medecine Aerospatiale; Aerospace Medicine Teaching and Research Center) is in charge of the experiments carried out under the direction of General Grandpierre. The Sud-Aviation Co. has integrated the nosecone of the rocket; Vesta was manufactured by LRBA (Laboratoire de Recherches Balistiques et Aerodynamiques; Ballistic and Aerodynamic Research Laboratory) of Vernon.

The launchings, eight days apart, of two monkeys aboard Vesta sounding rockets follow the first launchings, in 1961, 1962 and 1963, of three rats and two cats aboard Veronique sounding rockets. The objective of all these shots was to study the influence, on the living organism, of the most important factor met with during space flight: the absence of the force of gravity.

It might have been expected -- after the many hours of flight time accumulated by the American and Soviet astronauts (almost 2500 hours) -- that

this influence is now quite well known. In effect, physicians have already obtained a considerable amount of data on the effects of weightlessness on the internal part of the human ear, on the cardiovascular system, respiratory rate and the calcium content of the bones, and are now beginning to formulate certain explanations for these effects (see Air et Cosmos, 29 Jan 66 and 7 Jan 67). However only a few data are available on the modifications of human behavior in a state of weightlessness, notably with regard to the level of vigilance and the motor coordination of human acts.

It is uncomfortable for the astronaut to wear a large number of transducers on his body. Although it is quite easy to measure the respiratory and heart rate and the blood pressure during the entire flight, it is not very pleasant for the pilot to have to carry, under a helmet, electrodes which would permit to record the electric activity of his brain cells (EEG = electroencephalogram), or to have electrodes fixed to the antagonistic muscles of his arm in order to study the muscle contraction (myogram) and muscle tone.

On the other hand it is possible to perform these measurements on animals, and the Russians have carried out many such experiments during flight with rats and dogs, aboard both rockets and satellites. Until now the Americans have launched only a small number of animals into space, but they have a program of 6 biosatellites some of which remain in a 21-30 day orbit with different animals aboard (rats, hamsters, monkeys), and they are planning to launch two monkeys aboard a capsule to be dropped by an Apollo vehicle; these animals would remain in orbit for six months to a year. Moreover, certain recordings can be made only with animals: the electric activity of the brain can be studied much more precisely when the electrodes are placed into the tissues themselves (implanted electrodes) than when they are placed on the scalp.

Technical Difficulties

Unfortunately the experiments aboard sounding rockets suffer from two disadvantages. In the first place the time of flight is very short, and with the Vesta rockets the animals will be in a state of weightlessness for no more than 7-9 minutes. Moreover, this period of weightlessness in sandwiched in between a phase of acceleration and a phase of deceleration of the rocket, which are equivalent to an increase in the force of gravity and which may perturb somewhat the intermediate period. In the second place it is difficult to achieve a total absence of gravity, all the more so since the Vesta rocket is neither stabilized nor guided, and at any moment risks being subjected to various oscillations, which has happened during the three previous shots.

However, these are not the only technical problems. Another important question is that of retrieval. In effect, although most measurements are transmitted during the flight by two transmitters, the recovery of the nosecone is still important, since it is necessary to examine the films recorded aboard by a camera, and also to inspect the animals after their return to Earth. Now it happens that the recovery techniques of nosecones have not yet been fully mastered in France, and of the three principal methods tried in the past, none gave full satisfaction. During the Veronique shots, a cat and a rat could not be recovered. This time the recovery system has been designed by Latecoere, and includes the deployment of a parachute at a low altitude. The nosecone is equipped with a VHF beacon which guides the two helicopters and the plane in a rather extensive recovery zone (150 km).

Interesting Measurements

Despite these problems due to the use of sounding rockets which are not too highly perfected as yet, it is possible to obtain interesting measurements. Thus, during the tests with the rats and cats it was possible to observe, by means of the electrocorticograms, certain passages reflecting a special activity of the cortical cells and even of the reticular formation (which controls the activity of the cortex). Waves of large amplitude and low frequency -- rather comparable to the puffs and the large waves characteristic of a state of drowsiness and then of sleep -- were recorded without, however, obtaining the onset of a true state of sleep. These slow waves were interpreted as revealing a lowering of the vigilance level. An explanation of this phenomenon is not yet available. The scientists in charge of the experiment believe that while the force of gravity is experienced by the organism as a neutral stimulus, its disappearance may be felt as a new stimulus. This monotonous stimulus would promote a lowering of the level of vigilance, but it could also activate a certain brain region (vestibular nuclei) whose efferent paths leave toward the bulbar reticulum which has an inhibiting effect on the cortex. This possible influence of weightlessness on the brain has not been observed in the EEG's taken on the Gemini-7 astronauts, but then these recordings were made with the leads on the scalp and not directly in the tissues. However, it was observed during the various Gemini flights that the pilots had a tendency to fall into a state of drowsiness at certain moments, even when they were in the process of carrying out a certain task, or that they sometimes exhibited an unusual lack of attention.

Conditioning and Motor Coordination

The new Vesta shots, if they are successful, will no doubt contribute additional information on this subject. In effect, it is planned to carry out six electrocortigraphic measurements at different regions of the brain, in addition to preparing a pneumogram and cardiogram as was done in the previous cases; furthermore, an oculogram and three myograms (nape of the neck and antagonistic muscles of the forearm) will also be obtained. Monkeys of the Macaccus Nemestrinus species were chosen because of their small size and especially because their EEG is similar to that of man.

However the new experiments go further than the previous ones. It is planned, this time, to study how weightlessness effects the coordination of motor acts, and the time of response to a given stimulus. For this study, the directors of the experiment have conditioned the monkeys in such a way that they periodically accomplish a precise act, that of pressing one of the buttons on a panel facing them.

Here we have to do not only with a Pavlovian conditioning but also with an instrumental conditioning. The monkeys were taught to press one out of five buttons of the panel on board in such a way that if they choose the right button -- the central one -- they receive a reward in the form of a fruit paste. The apprenticeship which lasts about one or two weeks was reinforced by the application of an electric shock whenever the monkey pressed the wrong button. The conditional stimulus is a light signal: the monkey has learned to press the button only when a red light has been previously flashed on the panel.

Thus, during the flight the red light will be periodically flashed, at different time intervals, and the monkey will have to press the button; it will only receive the fruit paste when it has pressed the central button, but no electric shock will be administered if it presses another button. The monkey will work neither during the acceleration nor the deceleration phase. This active behavior on the part of the monkey will be obtained all the more readily since a basic element of motivation will be added to it: the monkey will be sent into space on an empty stomach.

The different transducers will then make it possible to study the motor coordination in a state of weightlessness. On the one hand the camera aboard will film the monkey and will see which button it presses, and whether the delay is due to hesitation, lack of attention or bad motor coordination, in which case the animal would find it difficult to reach the central button (it has been observed during the training of pilots that, in a state of weightlessness, the latter aimed at points situated higher than those which they wanted to reach, since their acts were coordinated as a function of the terrestrial force of gravity). On the other hand the electrodes implanted in the various regions of the brain will make it possible to measure the response times; the electrode fixed on the occipital level will record the voltage produced by the conditional light stimulus in the visual region, while the electrode implanted in the motor region will indicate the departure of the motor impulse toward the muscles of the body. The electrodes placed on the forearm will permit to record the electric activity of the muscles fibers. It will then be possible to compare all these measurements with those obtained on the ground in the presence of the force of gravity.

Two Vesta rockets were launched by the LRBA, on order by the CNES, on 15 Oct and 25 Oct 65, respectively. These were technological shots designed for checking the behavior of this sounding rocket operating on a two-liquid fuel (nitric acid and terpentine oil), which, with its total weight of 5.5 tons, occupies a position half way between Veronique and Emeraude.

Vesta is 9.95 m high and has a takeoff thrust of 14 tons and its combustion lasts 56-57 sec. On takeoff the rocket is stabilized with four cables during the first 100 meters of its course. Still the launching must be carried out at a low wind velocity, which explains why the launching was delayed by 24 hours at the beginning of this week.

The Vesta rocket was described in our issue No 125 of 6 Nov 65. It can carry a payload of 1000 kg to a height of 240 m.

[Caption of photo on p 17]: One of the conditioned monkeys practicing on its control panel.

2451
CSO: 4600-N

DAUPHIN, NEW SOUNDING ROCKET BY SUD-AVIATION

[Following is a translation of an unsigned article in the French-language periodical Air et Cosmos (Air and Cosmos), Paris, Vol 4, No 190, 11 Mar 67, p 20.]

Dauphin, to be launched from Hammaguir on about 22 Mar, is a rocket belonging to a new generation of sounding rockets of Sud-Aviation. Thus, the CNES, thanks to Dauphin and Eridan (the latter being another rocket of this generation), will have at its disposal a complete range of sounding rockets operating on solid fuel; these rockets are nonpiloted, have one or two stages, and are easy to use and economical. Other members of this series are the Belier, Centaure and Dragon, all of which exist but are in a process of being improved. This range of rockets will cover most of the needs of the researchers.

Dauphin is composed simply of the first propellant stage of the Dragon rocket. In effect some studies had been required in order to build the Dauphin, particularly with respect to the adaptation of a thermal shield. It is considerably lighter at takeoff than the Dragon rocket, and at the end of the propulsion stage, Dauphin will undergo accelerations of the order of 15 to 27 G, depending on the load (as against 13 to 15 G for Dragon), and consequently at an altitude of 10-12 km its speed will be considerably higher. This explains the increased heating up of the nosecone and the necessity of using a shield of insulating substance whose superficial ablation is capable, through sublimation, of absorbing the intense heat flux to which it is subjected.

The range of performances, on the other hand, is quite different. Dauphin will carry a calculated payload of 100 kg to a height of 238 km, or 300 kg to 125 km. The Dragon, consisting of two stages, carries a payload of 200 kg to an altitude of 233 km, or 30 kg to 600 km. On the other hand the single-stage Belier rocket carries only 20 kg to 100 km, and the two-stage Centaure rocket carries 30 kg to 205 km. Thus, Dauphin occupies a position midway between Centaure and Dragon, and its best zone of employment will be between 150 and 250 km.

The essential characteristics of the new French sounding rocket are as follows: Height 5.15 m (with a nosecone for a payload of 300 km); diameter 0.56 m; spread of the cross-shaped fin assembly 122.5 cm; weight of fuel block (solid) 685 kg ("Stromboli" fuel block, made of "Plastolane" powder); duration

of combustion 16 seconds; thrust 9 tons; weight on takeoff 1,150 kg (including 300 kg payload); peak altitude with 300 kg payload 125 km; time of ascent 180 seconds.

The launching of 22 Mar will be the first carried out with a Dauphin. This is a logistic shot, whose main purpose is to check the temperatures and test the launching ramp. Twelve Dauphines have been ordered by the CNES: nine pre-serial rockets and three for ground tests.

2451
CSO: 4600-N

THREE LASERS TRAINED ON DIADEME

[Following is a translation of an article by J.C. Trichet in the French-language periodical Air et Cosmos (Air and Cosmos), Paris, Vol 4, No 190, 11 Mar 67; p 31.]

The system of special telemetry by laser, forming part of the equipment of the Saint-Michel-de-Provence and the Stephanion stations, has been designed by the Research Center of the CGE (Compagnie Generale d'Electricite' General Electricity Co.) on order and with the financial support of DRME (Direction des Recherches et Moyens d'Essais; Research and Test Equipment Directorate).

The surveying operation organized by the CNES and executed by the Bureau of Longitudes (Bureau des Longitudes), the CNRS (Centre National de Recherches Scientifiques; National Center for Scientific Research) and ONERA (Office Nationald'Etudes et de Recherches Aerospatiales; National Office for Aerospace Studies and Research), with the assistance of DRME, is based on the simultaneous operation of several laser telemetry stations: two stations under the direction of CNRS at Saint-Michel-de-Provence and Stephanion in Greece, and a third station at Colomb-Bechar.

This third station is under the direction of ONERA. In effect, this organism is carrying out trajectography studies in agreement with the DRME.

It should be added that ONERA uses with the telemetry equipment designed by itself, a laser identical to that shown here, which has been placed at its disposal by CGE.

The targets used during these experiments are the two Diademe satellites launched last month.

A Cooled Ruby

The principle of laser telemetry has been discussed by Albert Duroque in our issue of 25 Feb. The equipment used comprises a ruby laser emitting a coherent light beam with a wavelength of 6943 A. It emits a pulse of 25 nano-seconds duration once every second, representing an energy of 1 joule for a peak power of 50 MW. The laser built by CGE us actually capable of operating at a rate of 10 pulses oer second, and the research center at Marcoussis has even obtained sequences of 15 pulses/sec. The operating rate of the laser used for the telemetering devices was reduced in order to take into account the climatic

factors of operation. The laser head is cooled with a liquid circulated in a cycle-reversing refrigerating unit.

[Caption to photo, left column, p. 31]: The data-processing unit of the spatial telemetering device comprises a chronometer having a precision of 10 nanoseconds. The frequency of the clock is 100 MHz. It is piloted by a thermostated quartz with a stability of 10^{-9}. The contents of the counters is automatically printed on a print unit after each measurement. The unit is placed in a shielded chassis (double enclosure of astatic mass), which protects it against the considerable radioelectrical perturbance caused by the emission of the laser flash.

2451
CSO: 4600-N

COMPLETE SUCCESS FOR DIADEME II

[Following is a translation of an article by Herve Ponchelet in the French-language newspaper Le Figaro, Paris, 15 March, 1967, page 8.]

The French satellite was reached simultaneously by three laser bursts emitted from Greece, the Sahara and Provence.

The CNES [Centre National d'Etudes Spatiales--National Space Studies Center] and ONERA [Office National pour l'Etude et la Recherche Aerospatiale --National Bureau for Aerospace Studies and Research] technicians were able to simultaneously receive laser echos from the "Diademe II" satellite when it was in its 346th revolution.

During that pass the Bechar station obtained 105 reflections, Haute-Provence obtained 6 and Stephanion 17. Thus, for the first time in the world, a space triangulation experiment using earth-bound laser telemeters has been carried out.

Sky plotters, spatial geometer, these terms have been used to describe "Diademe I" and "Diademe II". How is the experiment carried out in practice?

It is known that the geographical engineer is concerned with measuring triangles, in other words to locate with respect to one another three noticeable points (mountains, bell-towers, etc...). To do this he proceeds mainly by sightings.

Every student of elementary mathematics knows what solving a triangle means. He knows that if in such a figure an angle and two sides or two angles and one side are known, then it is possible to calculate the values of the other elements of the triangle by simple formulas.

Let us return to the experiment being carried out. Here, what we want to calculate are the dimensions of the triangle Saint-Michel-de-Provence, Colomb-Bechar (or rather Bechar now), Stephanion. What has "Diademe" got to

do with all this?

Let us imagine the satellite passing over this unknown triangle on one of its revolutions. The satellite and the three points of the triangle form a pyramid. This pyramid obviously has four sides of triangular shape. The base triangle Bechar, Stephanion, Saint-Michel-de-Provence, which we will call P (Provence): B (Bechar); G (Greece) is not measurable by optical methods because from one of these points it is not possible to see the others because of mountains, the atmosphere and the earth's curvature. However, the satellite can be seen from P, B or G during its favorable passes. If it is possible to measure the triangle P, B and "Diademe", then the sought-after distance B-P will also have been measured. This will also be true for the B, G satellite and O, P satellite triangles.

Modern techniques offer a method of measuring the distance from a ground station to a satellite with great precision: laser telemetry, which was described previously. If it is possible to receive reflections off the satellite simultaneously at Bechar (B) and Haute-Provence (P) then two sides of the B, P satellite triangle will be known.

In order to calculate the third side--which is the object of the experiment, an angle must be known. Unfortunately, while the laser is very precise in the measurement of distances, it is of little or no use in measuring the sighting angle. We get around this by photographing the satellite against the background of the stars, the positions of which are very well known. Thus at a given instant we can deduce the position of the satellite, or the required angle.

These photographs are taken at the Nice Observatory, the location of which with respect to the Haute-Provence Observatory is known exactly by means of normal geodesy. Thus it is possible--by means of very complex calculations --to deduce the required angle. Having two sides and one angle of the P, B satellite triangle the third side, the distance from Bechar to the Haute-Provence station, can be found.

The same holds true for the two other sides of the PGB triangle, if the Bechar-Stephanion and Stephanion-Haute-Provence shots are combined. Triangle by triangle the specialists are able to determine the desired terrestrial distances.

However the satellite is not a fixed point in the sky. If it is desired to make the measurement in one go it is necessary to synchronize the laser pulses in order that the measurements all correspond to the same pyramid.

The pulses cannot be strictly synchronized, but calculations can compensate for this small error. In addition , the photographs are not taken from one of the vertices of the triangle. There again, it is possible to compensate by calculations. Furthermore, the measurements made by laser and by photography are combined with those of the Doppler stations. More calculations are made. When we asked M. Kovalevsky--the director of this experiment

--about details of the method used, he told us that apart from the principles described here, everything consisted of formulae, equations and calculations which a mathematical purist would certainly repudiate.

7104

CSO: 4600-D

"DIADEME II" PHOTOGRAPHED AGAINST STELLAR BACKGROUND

[Following is a translation of an unsigned article in the French-language newspaper Le Figaro, Paris 17 March, 1967, page 12.]

The experiment in space geodesy being carried out with the aid of the "Diademe II" satellite is progressing very well. Following the success of the laser telemetry experiment, the one on photographing the satellite against the stellar background has now been carried out by the Nice observatory.

The team led by Professor P. Muller has obtained good pictures of the device with the aid of the French large-aperture camera, the first tests of which lead to the belief that these optical observations will furnish the expected contribution to the space geodesy operation when combined with the Doppler and laser measurements.

7104

CSO: 4600-D

SUCCESSFUL LAUNCHING OF A SECOND VESTA WITH MONKEY ON BOARD

[Following is a translation of an unsigned article in the French-language newspaper Le Figaro, Paris, 15 March 1967, page 8.]

A second Vesta probe-rocket carrying a guenon monkey into space for a 12-minute suborbital flight was launched yesterday from the Armed Forces Special Devices Test Center [CIEES] at Hammaguir.

The experiment, which was a repetition of the one on the 7th of March, was completely successful. The object was to study biological reactions and the electrical activity of certain regions of the animal's brain.

The rocket reached a peak altitude of 240 km. Its working was excellent throughout the flight. The nose cone was recovered in perfect condition 120 km from the launch site, 20 minutes after the firing of the missile. The monkey was found to be in very good health. The data gathered during the flight will now be analyzed.

- END -

7104

CSO: 4600-D